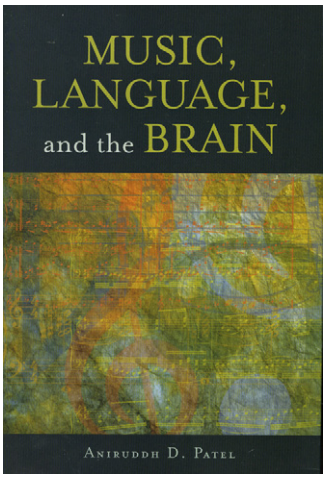
Cell PRESS
Neuron
Book Review

Musically Speaking



Music, Language, and the Brain

Aniruddh D. Patel
Oxford University Press (2007)
528 pp., $62.95, hardcover.

The relation between music and language has been intriguing to everyone from Charles Darwin to Leonard Bernstein, touching as it does some of the core questions of what it means to be human. In his new book, *Music, Language, and the Brain*, Aniruddh Patel offers a wide-ranging survey of this topic, with an emphasis on empirical approaches to the issue, but without shying away from speculation in areas of knowledge where (alas, all too often) hard data are lacking. What's great about this volume is that it provides an all-in-one compendium of a huge amount of information, nicely organized, with appropriate illustrations, and lavishly referenced throughout. It would serve very well as a text for graduate seminars or as a source for scholars from one domain who wish to learn more about a related domain. It is not meant to popularize or proselytize; complexities are not oversimplified, flashiness is avoided, and technical language is used as needed. And yet, it is highly readable and should be relatively accessible even to readers without specific training in psychology, neuroscience, linguistics, or music. Although there are a few idiosyncratic treatments of certain issues, overall Patel succeeds at balancing his own points of view with those of others. The strongly empirical approach espoused by Patel sets this book apart from more theoretically oriented approaches to music and language, such as Lerdahl and Jackendoff's *Generative Theory of Music*. Patel pays much more attention to experimental evidence concerning how music and language are perceived and produced by the cognitive system rather than to formal analysis of structure based on texts, which may or may not be relevant to actual processing. This book is perhaps most comparable to another highly readable book, Stephen Handel's *Listening*, in its scope and approach but differs from it in its focus specifically on the relation between music and language and, of course, from being much more up to date, an important consideration in this very dynamic area of research.

Despite the book's overall excellence, the neuroscientist accustomed to the type of science typically presented in a *Neuron* article may come away disappointed if he or she expects a certain level of mechanistic detail of speech- or music-related phenomena. Although a great deal of cognitive neuroscience material is covered, Patel does not for the most part delve into the details of the neural mechanisms behind music or speech processing. This in part reflects the state of the field, where such knowledge is still fragmentary for the most part. But it also seems a conscious choice, given the more psychological orientation of the author and the intended readership. Thus, for example, there is relatively little discussion of the neurophysiological properties of relevant cortical or subcortical neurons that might be relevant to music or to speech. A discussion concerning the acoustic features that auditory cortical neurons are sensitive to might have provided relevant evidence to address some major issues that are brought up in the book. For instance, the degree to which music and speech depend on overlapping mechanisms or the degree to which such processing may be shared with other animals can be addressed in part by knowing about neural sensitivity to pitch. Recent neurophysiological data in marmosets indicate the existence of neurons that seem to encode pitch information, irrespective of the acoustical details of the stimulus; the location of these neurons is highly consistent with human lesion and neuroimaging evidence, arguing for a cross-species commonality in this fundamental system, relevant both to speech and music. Another neurophysiological mechanism that is not discussed but that could be pertinent to the issues brought up in the book is the mirror-neuron system. Although the mirroring concept has perhaps been somewhat abused in the literature of late, as providing explanations for almost anything, its consideration in the realm of music and speech would likely be quite relevant, given that both depend a great deal on imitation of acoustical inputs by modeling motor outputs. Again, a consideration of the cross-species similarities in this system might be helpful in evaluating evolutionary precursors to music and speech, a topic considered in the book's last chapter.

Putting aside the more neuroscience-oriented questions, Patel does an excellent job of elucidating some of the major psychological issues that are the focus of current theory and experimentation. One of the themes that runs throughout the text is the question of to what extent music and language depend on shared neural and/or psychological mechanisms as opposed to unique ones. Patel tends toward the nuanced interpretation that there is more sharing than is often taken into account, while at the same time acknowledging some of the important distinctions across the two domains. In some respects, the whole concept of domain specificity, which has been a prominent concept in cognitive psychology in the past few decades, seems to be giving way in light of greater detail in our understanding of the neural bases of cognitive processes. Consider for instance the question of whether speech is processed via a dedicated neural system, unique to it and not to other signals, such as musical ones. This proposition, which dates back at least as far as Liberman's models of the 1950s, can be supported by a variety of evidence; yet, it seems increasingly unlikely that one can

meaningfully speak of a neural module for speech as such. To be sure, there is clear evidence that the linguistic nature of a speech signal can alter its neural processing; for instance, a sound perceived as a meaningful word by one listener but not by another, by virtue of their different language knowledge, will yield different patterns of brain activity. By the same token, however, it seems clear that the auditory cortex processes all incoming signals whatever their higher-order properties, in order to extract and ultimately represent the acoustic features they contain. A possibly more fruitful way to consider the issue of domains is to think in terms of what neural pathways are involved, and how bottom-up sensory processing is modulated by top-down influences, which in turn are dependent on factors like memory—that is, the history of an individual's interactions with the environment. Coming back to the issue of shared versus distinct representations in music versus language, one might propose that rather than asking whether music and speech overlap in the brain (they will inevitably do so in some places and not others), it might be better to ask how a given signal is processed based on the interactions between its acoustic features on the one hand and the task demands, memory representations, and cognitive state of the listener on the other. Although here we are mostly thinking of perceptual processes (also more prominently featured in the book than production), many of the same arguments would apply to motor control issues involving singing, speaking, or playing a musical instrument. No doubt there are overlapping demands in terms of planning, sensory-motor feedback, and so forth across speech and music, but also some unique features (speaking versus playing a xylophone are pretty different for instance). But again the question is perhaps better articulated in terms of what each task demands of the nervous system.

One of the book's great strengths is its insistence on the importance of cross-cultural approaches to the study of music and language. All too often, studies that make sweeping conclusions regarding these complex phenomena are based only on one language (usually English) and one musical system (Western tonal). Patel makes both an eloquent plea and also provides solid experimental evidence to explain why comparisons of different linguistic and musical systems are likely to yield much more fundamental insights. We can only echo this conclusion and simply wish that on a practical level it were easier to implement. Another good feature of Patel's approach is his insistence of the relevance of cross-species comparisons. This comes out best in the chapter on evolution, where he carefully considers a variety of behavioral evidence concerning similarities and differences between humans and other species, giving the book a broader scope than is typical for music psychology. The chapter on evolution is, in fact, one of the best ones in the book, as it attempts to lay to rest what Patel aptly describes as a false dichotomy between those who argue that music is a useless frill versus those who argue that music is an adaptation specifically emerging from natural selection. Although his careful review of the evidence leads him to argue against the concept of selection for music—or at the very least to point out that it remains far from proven—he suggests that this need not mean it has no functionality or importance in shaping human culture. Indeed, he carefully parses the arguments, often conflated, concerning usefulness of features versus selected features of behavior. His general argument is that specializations for music, both neural and behavioral, can parsimoniously be explained on the basis of other selective pressures, most notably those for speech and language; but that once music came into existence, just like fire or the internet, it changes things in particular ways such that it becomes an essential part of the human experience.

Overall, this is a highly recommended read. It is stimulating and wide-ranging and contains material that readers of many backgrounds and levels will find interesting. It will also, we hope, serve as inspiration to new generations of scholars and scientists who can take an interest in the many unanswered questions that this book highlights.

Robert Zatorre[1,*]
[1]Montreal Neurological Institute, McGill University and International Laboratory for Brain, Music, and Sound Research (BRAMS), Montreal, QC Canada H3A 2B4
*Correspondence: robert.zatorre@mcgill.ca
DOI 10.1016/j.neuron.2008.11.001